



IPS DIGITAL D-TYPE MODULE USER GUIDE

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Product View and Connector Pinout

This chapter consists of the product view mechanical drawings, connector pin out, and standard product configurations.

Image 1.0: Mechanical Drawing –Digital D-Type

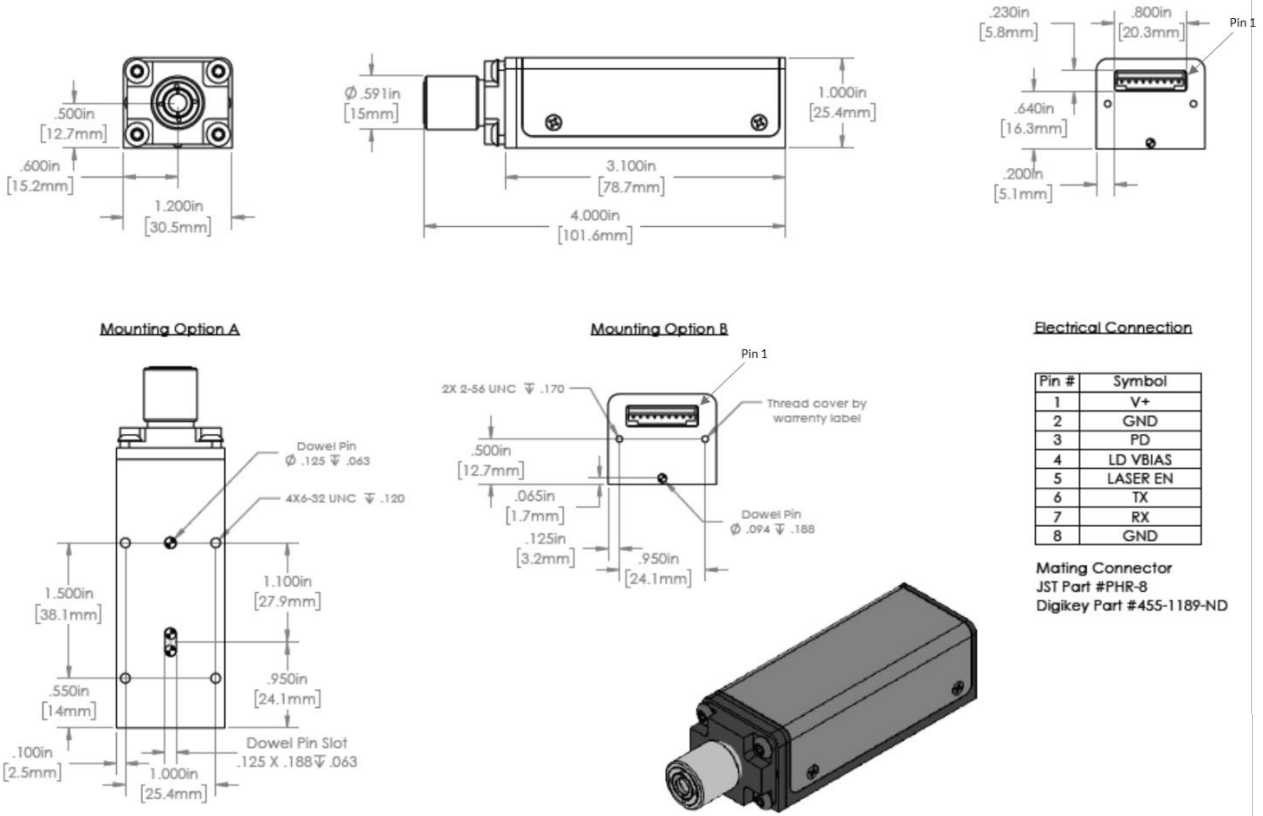


Table 1.0: Digital D-Type JST Part# S8B-PH-SM4-TB(LF)(SN) Connector Pinout (12" long I/O cable Provided)
(Mating connector part number: JST Part# PHR-8)

Pin #	Symbol	Wire Color	Description	Notes
1	VCC	Red	Supply Voltage	5 V DC, 1 Amp
2**	GND Return	Gray	Ground Return	Need to connect to Signal Ground
3	PD	Gray	Linear Tracking PhotoDiode	Voltage Proportional to PD Current
4	LD SET	Gray	Laser Power Control	0.0 V DC - 0.2 V DC - Disabled by default
5*	LD Enable	Gray	Laser Enable	5 V TTL, See Note 1 Below
6 [§]	Tx	Gray	Transmit	Digital I/O (UART 3.3V)
7 [§]	Rx	Gray	Receive	Digital I/O (UART 3.3V)
8**	Sig GND	Gray	Signal Ground	Tie to GND Return (Pin 2)

Pins 1, 2, 5*, and 8** are required for laser operation**

Notes:

- * Laser Enable is required unless module is set to “Always On” Laser Enable Mode (Mode 2)
- ** GND must be supplied to both GND pins (pin 2 and pin 8)
- § Transmit from host connects to Rx on Laser Module, receive on host connects to Tx on Laser Module

Product Specifications and Standard Configurations

This chapter consists of the product specifications, standard wavelength configurations, and product options.

Single Mode Digital D-Type Module

GENERAL OPTICAL SPECIFICATIONS:

Standard Wavelengths*	633nm, 638nm, 780nm, 783nm, 785nm, 808nm, 830nm, 976nm, 1030nm, 1053nm, 1064nm
Wavelength Tolerance	+/- 0.5nm
Narrowed Linewidth Spectral Linewidth	< 100MHz
Wavelength Stability Temperature Range	15°C – 45°C
SMSR	45dB – 55dB
Output Power Stability	<1% at constant case temperature
Polarization Orientation	Perpendicular to base plate of laser module
Polarization Extinction Ratio (PER)	>17dB, 20dB typical
Modulation Rate	Digital Modulation: 1KHz External Modulation: CW to 10kHz at 50% duty cycle or CW to 1kHz at 10% - 100% duty cycle
Warm-Up Time	Cold Start: 10 seconds Warm Start: 1.5 second

PHYSICAL SPECIFICATIONS:

Beam Diameter at Output	4.0 mm (+/- 0.4mm) with beam expander as measured 1/e ² @ 2.4m from laser exit ~0.7 mm without beam expander
Beam Divergence	<1 mrad with beam expander ~ 2 mrad without beam expander
Beam Quality (M ²)	< 1.5 (<1.3 Typical)
Beam Ellipticity	<1 : 1.5 (1 : 1.1 Typical)
Electrical Connector	JST Part# S8B-PH-SM4-TB(LF)(SN) (Mating connector part number: JST Part# PHR-8)
Module Dimensions	4.0in (101.6mm) x 1.2in (30.5mm) x 1in (25.4mm)
Module Weight	5.3 oz. (150g)
Case Material	Anodized Aluminum
Case Temperature Range (Operational)	-10°C - 45°C
Internal Cooling Air Flow	100 LFM with attached heatsink
Environment	0% - 80% humidity, non-condensing
Storage Temperature	-50°C – 90°C
Regulatory	RoHS 2.0 Certified Exempt from CFR Title 21 1040.10 and 1040.11 (component/replacement part)

ELECTRICAL SPECIFICATIONS:

Supply Voltage	4.9Vmin – 5.1Vmax
Power Consumption	3W – 5W typical 15W maximum

* Additional wavelengths may be available, contact IPS at www.ipslasers.com



Laser Communication Set-Up and Operation

This chapter is an overview of the Digital D-Type laser operation. It includes laser set-up, digital interface instructions, command syntax, and a list of software commands.

Module Communication Set-Up and Power On

1. Connect power supply to the Digital D-Type module via the JST connectorized wiring harness provided with the unit.

To properly power the unit, connect the voltage source to pin 1. Connect GND to pins 2 and 8. Pins 2 and 8 must be tied together.

***Please note, a USB connection alone is not enough to power the laser. The laser must be powered via the JST connector in the above listed manner to ensure adequate power.**

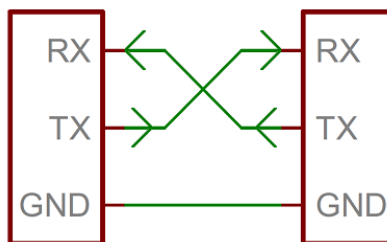
2. Connect TTL signal source to the Digital D-Type module via the JST connector

Connect pin 5 (ENABLE) to a TTL signal source for operation with module set in mode 0 (Rising Edge – Factory default) and mode 1 (TTL). No connection to pin 5 is needed if the module is operating in mode 2 (Always On). IPS recommends operation in rising edge mode to ensure safe operation. This mode of operation ensures that the laser can not re-energize when power is disrupted (and subsequently restored) to the module without operator intervention. Users may change the laser enable mode of the Digital D-Type module by changing this parameter in the unit’s firmware. This can be accomplished by utilizing the command line interface detailed in the command reference portion of this user guide.

When utilizing both Rising Edge and TTL laser enable modes, the unit’s Pin 5 (ENABLE) must be driven at TTL HI (>3.6V).

Pin 5 (ENABLE) can be used to turn the laser off in case of emergencies by driving to TTL LO (GND).

3. Connect the Digital D-Type module to the host system by connecting the Tx from the host to the Rx (Pin 7) on the laser module and the Rx on the host to the Tx (Pin 6) on the laser module



If USB or RS232 communication is desired, connect the wiring harness to a suitable UART to USB or RS232 adapter. IPS offers Digital D-Type communication accessory kits (D-Type-BK-USB & D-Type-BK-RS) for this purpose. Contact IPS for additional details.

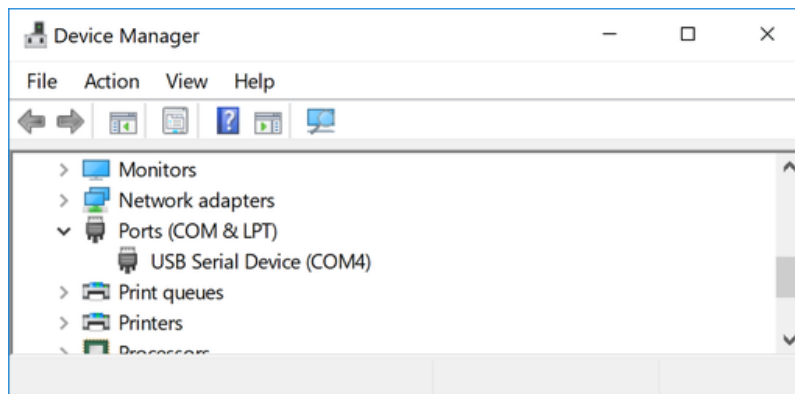
4. Ensure the Digital D-Type module is recognized by the host system by opening the Windows® Device Manager. If using an alternate Operating System, please contact IPS for additional details on verifying device recognition.

Locate “Ports (COM & LPT)” in the Device Manager. Ensure “USB Serial Device (COM#)” is present.

If “Ports (COM & LPT)” does not appear, it’s possible it is hidden (select the “View” drop down and “Show hidden devices”). If “Ports (COM & LPT)” still does not appear, please visit the Microsoft® answers page to view steps to enable legacy hardware.

The Digital D-Type module uses a serial interface, with COM port settings of 115200 baud and 8N1 configuration.

Image 2.0: Digital D-Type module recognized by Microsoft® Device Manager



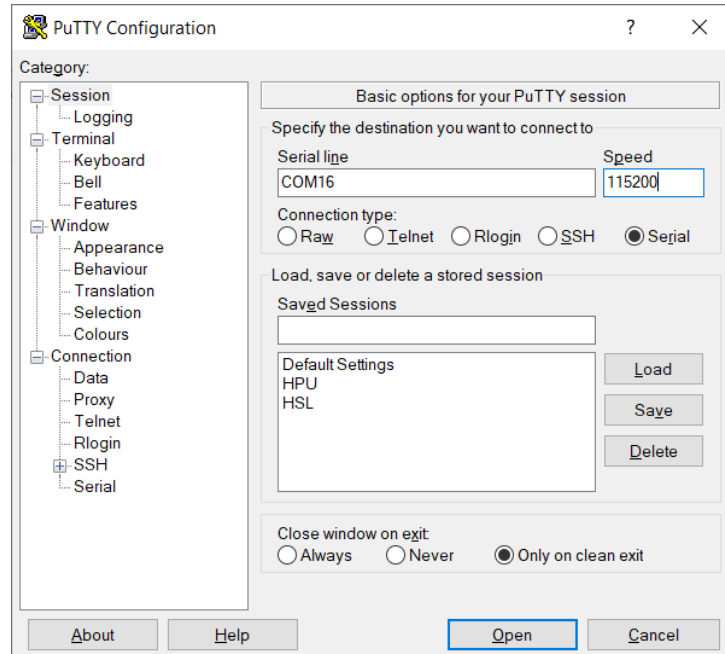
5. Test the Digital D-Type module functionality

Use a serial port monitor program to test the device functionality.

The open source program "PuTTY" (<https://www.putty.org/>) can be used to test the device manually.

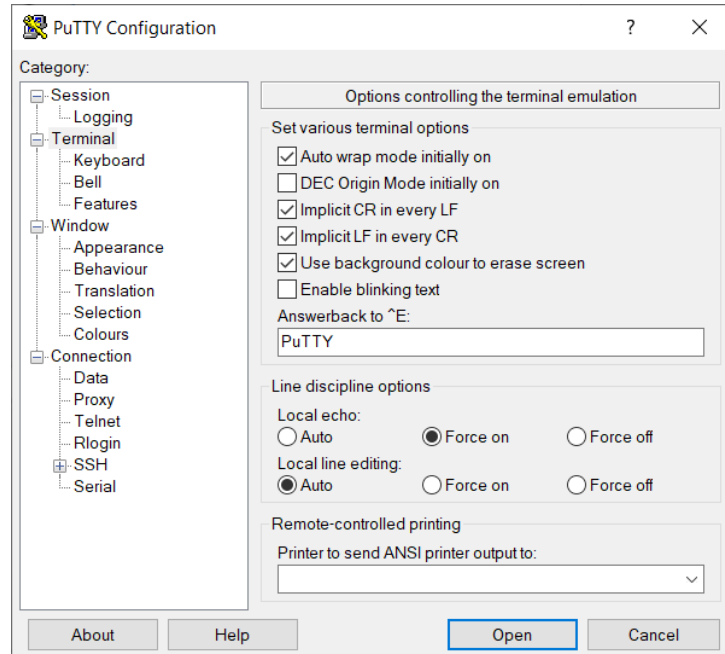
6. Before starting the session, configure the “Session” via the “Session” menu and setting the following:
 - i. Verify the correct COM port is populated in the “Serial line” input box
 - ii. Manually set “Speed” to 115200
 - iii. “Connection type” should be set to “Serial”

Image 2.1: “PuTTY” Session Configuration



7. Configure the "Terminal" by accessing the "Terminal" menu and enabling:
 - i. "Implicit CR in every LF"
 - ii. "Implicit LF in every CR"
 - iii. "Local echo:" Force On

Image 2.2: "PuTTY" Terminal Configuration

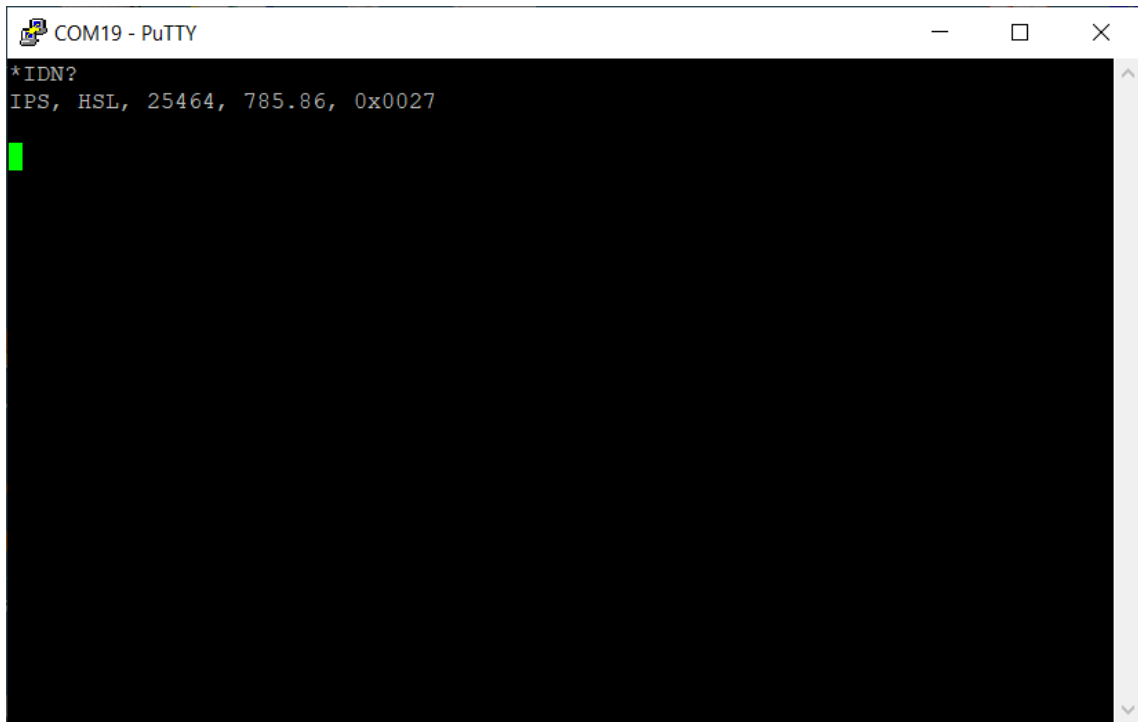


8. Ensure the device is correctly connected to the host system

Send the command `"*IDN?"`

The device should respond with "IPS, HSL, laser serial number, laser wavelength, firmware version". This confirms the device is correctly connected to the host system.

Image 2.3: "*IDN?" Command Line Example



UART Communication

UART is the communication protocol used by this module. This communication standard allows the customer to integrate the unit directly into their system or to connect an aftermarket adapter to allow for computer interface. Aftermarket adapter for both USB and RS-232 connectors are widely available. IPS also offers a turn key accessory kit to interface this module with your computer (contact IPS for additional information, reference part numbers D-Type-BK-USB & D-Type-BK-RS).

Command Syntax

This section describes command syntax and structure. This information must be understood in order to effectively write a control program. The syntax of commands follows the rules defined in the Standard Commands for Programmable Instruments (SCPI v1999.0) standard. This standard is based on the IEEE 488.2 standard.

Letters

Commands must contain all of the letters shown in uppercase in the command definition. Optional letters shown in lowercase for some device dependent commands in the command reference are useful for clarity. If any of the optional letters are included, they must **all** be included, in the correct sequence. Some examples of what works and what does not are shown in Table 1 below.

Table 1 – Examples of Acceptable and Not Acceptable Syntax Commands

DEFINITION	ACCEPTABLE	NOT ACCEPTABLE
TEC:SETpoint	TEC:SET or TEC:SETpoint	TEC:S or tec:setp
LASER:ENable	LASER:EN or LASER:ENable	LAS:EN or LASER:ENab

White Space

“White space” is any number of space characters (space bar). A white space must separate a command from its parameters or data. Examples are shown in Table 2.

Table 2 – Examples of White Space

ACCEPTABLE	NOT ACCEPTABLE
LASER:EN 1	LASER:EN1

A query has no space between the mnemonic and the question mark. Examples are shown in Table 3.

Table 3 – Examples of Proper Syntax for a Query

ACCEPTABLE	NOT ACCEPTABLE
*IDN?	*IDN ?

Terminators

A program message terminator identifies the end of a command string. Valid terminator sequences are <LF> (linefeed), <CR> (carriage return) and <CR><LF> (carriage return / line feed). The Digital D-Type module terminates its responses with <CR><LF>.

Command Separators

More than one command may be placed in the same command string if each command is separated by a semicolon. The semicolon can be preceded by one or more spaces. For example:

```
OUTPUT ON;*IDN?;SYSTEM:ERROR?
```

```
OUTPUT ON ; *IDN?; SYST:ERROR?
```

The Digital D-Type will respond to multiple queries within the same command string by separating each response with a command separator.

Parameters

Some commands require a parameter. The parameter must be separated from the command by white space.

The syntax symbol <numeric_value> refers to the flexible numeric representation described by section 7.7.2.1 of IEEE 488.2. Some numbers may be represented with or without a decimal point and with or without exponent. Whitespace is not accepted on either side of the decimal or after the sign character, but is acceptable on either side of the “e/E” exponent character. For example, the number “twenty” may be represented by any of the following ASCII strings as depicted in Table 4.

Table 4 – Examples of ASCII Strings

NR1	Integer	20	+20
NR2	Floating Point	20.0	+20.0
NR3	Scientific Notation	2 E 1 2.0e+1	+2.0E+1 +2.0 e1

Command Reference

This chapter is a guide to all of the commands for the Digital D-Type Laser controller. This chapter is divided into three parts.

- ✓ Remote command reference summary
- ✓ Detailed list of remote commands in alphabetical order
- ✓ List of hardware and software error codes

Remote Command Reference Summary

This section contains all of the commands for the Digital D-Type.

Table 5 – Remote Command Summary (Listed Alphabetically)

NAME	FUNCTION
*IDN?	Returns the Device Identification string including S/N, wavelength, & Firmware version
BOARD:TEMPerature?	Report the Board/Case temperature (°C)
ERRor?	Queries the errors in the hardware error queue
LASER:CURrent <current>	Set Laser Operating Current Setpoint (mA)
LASER:CURrent?	Report Laser Operating Current (mA)
LASER:DUTYcycle [0 1]	Set the Laser PWM Duty Cycle
LASER:DUTYcycle?	Report the Laser PWM duty cycle
LASER:ENable [0 1]	Enable/Disable Laser Operation
LASER:ENable?	Reports Laser enabled status
LASER:HOURs?	Report the number of hours of ON time of the unit
LASER:MODE:ENable [0 1 2]	Set the Laser Enable Mode (Rising Edge, TTL, Always On)
LASER:MODE:ENable? [0 1]	Reports the current enable mode of the laser (Rising Edge, TTL, Always On)
LASER:MONitor?	Report the Monitor Photodiode Signal level (mV)
LASER:PWM:ENable [0 1]	Set Laser PWM Mode On/Off
LASER:PWM:ENable? [0 1]	Reports the Laser PWM Mode
LASER:TEMPerature?	Report the current Laser/TEC Temperature (°C)
PARAMeters:REStore	Restore Setting to Factory Default
PARAMeters:SAVE	Save the current settings as Power-Up defaults
STATus?	Reports the Board State and number of errors in the hardware error queue
SYSTem:ERRor:COUNT?	Reports the number of errors in the communication error queue
SYSTem:ERRor?	Queries the errors in the communication error queue.
TEC:SETpoint <temperature>	Sets the TEC temperature Setpoint (°C)
TEC:SETpoint? [0 1]	Reports TEC temperature Setpoint (°C)

Detailed Command Reference

The following pages contain a reference for commands for the Digital D-Type Laser controller.

*IDN?

Instrument Identification

Description	Requests the instrument to identify itself
Parameters	None
Notes	Returns a string of instrument identification information. The string contains a comma separated list of manufacturer, electronic driver, serial number, wavelength and firmware revision.
Examples	"*IDN?" Response: "IPS, HSL, 12345, 785.23, 0x0027"

BOARD:TEMPerature?

Description	Reports the Board/Case Temperature in °C
Parameters	None
Examples	BOARD:TEMP? Response: "30.00" - indicating a 30.00°C temperature

ERRor?

Description	Returns the hardware error number, a sub-code and a brief description
Parameters	None
Response	ASCII character string containing an error number and a brief description
Notes	If more than one error has occurred, repeated error queries are required until the response is "0, No error". See below for a list of Hardware Error Codes .
Examples	ERR? – Response: 0, 0, "No_error" - means no errors to report. ERRor? – Response: 3097, 0, "Failed_initial_POST" - means the initial Power-on self-test failed at location "0".

LASER:CURrent <current> LASER:CURrent?

Description	Sets the target operating current / Reports the measured laser operating current
Parameters	The laser operating current in mA.
Examples	LASER:CUR 200.0 – Sets the operating current for the laser to 200.0 mA. LASER:CURrent? – Response: "200.025" - indicating a 200.0 mA current flowing through the laser

LASER:DUTYcycle <duTy_cycle>

Description Sets the laser PWM duty Cycle

Parameters The duty cycle in percent [0..100]

Examples LASER:DUTY 50.0 – Sets the PWM duty cycle for the laser to 50.0%.

Note The on-board clock frequency for the Digital D-Type operates at 1 kHz, so pulse width modulation schemes may be set from 10% to 100 %. PWM values below 10% may not track linearly.

LASER: DUTYcycle? [0|1]

Description Reports the current laser PWM duty cycle

Parameters 0: Report Current setting (default)
1: Report factory Default setting

Examples LASER:DUTYcycle? 0 – Response: “25.0” – Reports laser is currently set to a 25.0% PWM duty cycle
LASER:DUTY? 1 – Response: “50.0” – Reports factory default setting of the laser is set to 50.0% PWM duty cycle

LASER:ENable [0|1]

Description Sets the enabled state of the laser

Parameters 0: Disables the Laser
1: Enables the Laser

Notes The actual ON/OFF state of the laser is determined by a combination of hardware and software. If the Laser is disabled through this command it will be OFF. When it is enabled its ON/OFF state will depend on the hardware enable state. Refer to the Digital D-Type or D-Type Tethered Head manual for a detailed operational description for operating the module.

Examples LASER:EN 0 – Disables the laser

LASER:ENable?

Description	Returns the enabled state of the laser
Parameters	None
Examples	LASER:ENable? – Response: “1” - Laser is enabled

LASER:HOURs?

Description	Returns the number of hours that the unit has been ON.
Parameters	None
Return	A floating point number in hours
Examples	LASER:HOUR? – Response: “100.34” - meaning laser has been on 100.34 hours

LASER:MODE:ENable [0|1|2]

Description	Sets the Hardware Laser Enable Mode
Parameters	0: Laser turns ON a “rising edge” and OFF on the falling edge 1: Laser turns ON when input level high, OFF when input level is low 2: Laser is “always ON” (independent of hardware input state on pin 5 of connector)
Examples	LASER:MOD:EN 0 – Set laser enable mode to rising edge

LASER:MODE:ENable? [0|1]

Description	Reports the current laser enable mode
Parameters	0: Report Current setting (default) 1: Report factory Default setting
Examples	LASER:MOD:EN? 0 – Response: “2” – Laser is “always ON” when power is applied LASER:MOD:EN? 1 – Response: “0” – Laser factory default is “rising edge”

LASER:MONitor?

Description	Report the Monitor Photodiode Signal level
Parameters	None
Examples	LASER:MON? – Response: “3.13” - Reports the monitor photodiode signal level (mV)

LASER:PWM:ENable [0|1]

Description	Sets the Laser PWM Mode
Parameters	0: Do Not use Laser PWM 1: Use Laser PWM
Examples	LASER:PWM:EN 0 – Turn off PWM control for the laser

LASER:PWM:ENable? [0|1]

Description	Reports the current laser PWM mode
Parameters	0: Report Current setting (default) 1: Report factory Default setting
Examples	LASER:PWM:EN? 0 – Response: “1” – Reports laser is using PWM mode LASER:PWM:EN? 1 – Response: “0” – Reports factory default setting of the laser PWM mode is off

LASER:TEMPerature?

Description	Reports the measured Laser diode operating temperature in °C
Parameters	None
Notes	This is the measured actual operating temperature of the laser. Use TEC:SET? to retrieve the setpoint temperature
Examples	LASER:TEMP? - Response: “30.00” - Reports a 30.00°C temperature

PARAMeters:REStore

Description	Restores the default power-up configuration to its factory default
Parameters	None
Notes	The parameters restored are: TEC_Setpoint, Laser_Drive, Laser Enable Mode, Digital mode enable and PWM duty cycle.

PARAMeters:SAVE

Description	Save current settings to FLASH for use as default power-up configuration
Parameters	None
Notes	The parameters stored to FLASH are: TEC_Setpoint, Laser_Drive, Laser Enable Mode, Digital mode enable and PWM duty cycle.

STATus?

Description	Requests the hardware status of the Digital D-Type.
Response	2 decimal numbers, the first number represents the board state: 0 = unknown state, 1 = board passed POST (Power On Self-Test) 2 = board failed POST (Power On Self-Test) 3 = board in normal state 4 = board in fault state 5 = board in boot load state 6 = board not attached

The second decimal number is the number of errors in the hardware error queue. Use the "ERRor?" to read the hardware error code and information.

Example STAT? – Response: "3, 0" – Reports board is in normal state with no errors.

SYSTem:ERRor:COUNT?

Description	Requests the number of communication errors that may have occurred.
Parameters	None
Response	Number indicating how many errors are stored in the communications error queue
Examples	SYST:ERR:COUN?- Response: 0 - Reports no errors in communications queue. SYST:ERR:COUNT?- Response: 2 - Reports 2 errors in communications queue

SYSTem:ERRor?

Description	Requests communication errors that may have occurred.
Parameters	None
Response	ASCII character string containing an error number and a brief description.
Notes	If more than one error has occurred, repeated error queries are required until the response is "0, No error". See below for a list of Communication Error Codes .
Examples	SYST:ERR?- Response: "0, No error" - Reports no errors to report. SYSTem:ERRor? – Response: "-109, Missing parameter" - Reports a parameter was missing from a command.

TEC:SETpoint <temperature>

Description Sets the target temperature for the TEC.

Parameters Number between 10.00 to 45.00 – The set point temperature in °C for the TEC.

Examples TEC:SET 30.00 – Sets TEC setpoint temperature to 30.00°C

TEC:SETpoint? [0|1]

Description Reports the setpoint temperature for the TEC.

Parameters 0: Report current setting (default)
1: Report factory Default setting

Examples TEC:SET? 0 – Response: “25.50” - Reports current TEC setpoint is 25.50°C
TEC:SET? 1 – Response: “30.00” – Reports factory default temperature setpoint is 30.00°C.

COMMUNICATION ERROR CODES

- 102 - Syntax error
- 103 - Invalid separator
- 113 - Undefined header
- 108 - Parameter not allowed
- 109 - Missing parameter
- 131 - Invalid suffix
- 138 - Suffix not allowed
- 200 - Execution error
- 224 - Illegal parameter value

HARDWARE ERROR CODES

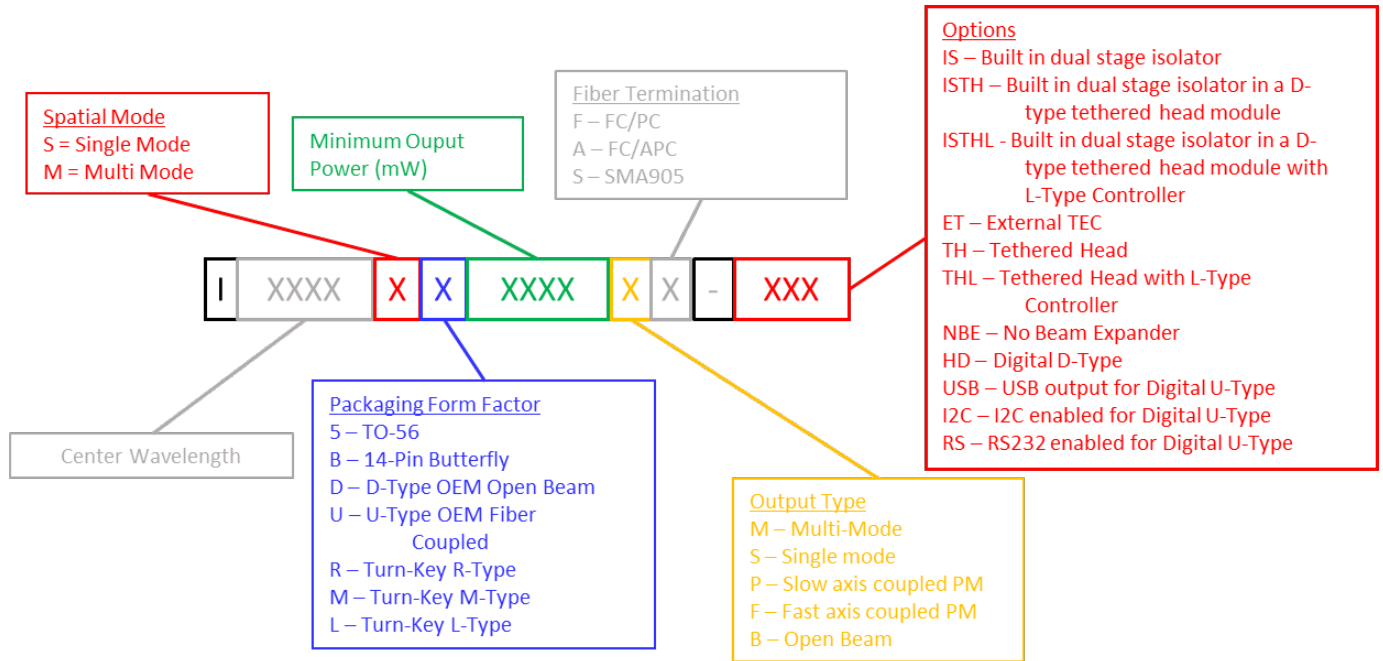
- 0 - NO_ERROR
- 3011 - HOUSEKEEPING
- 3012 - FLASH_INITIALIZATION_FAILED
- 3013 - FLASH_HOUSEKEEPING_FAILED
- 3014 - LOW_VOLTAGE_EVENT
- 3015 - BAD_VOLTAGE_3V3
- 3016 - BAD_VOLTAGE_VIN
- 3017 - BAD_VOLTAGE_VTEC
- 3018 - HIGH_INPUT_CURRENT

- 3019 - TEC_UPDT_ON_BRD_STATE_BAD
- 3020 - TEC_UPDT_ON_TEMP_LONG_BAD
- 3021 - TEC_UPDT_ON_TEMP_OUT_SETPT
- 3022 - TEC_UPDT_ON_TEMP_OUT_RANGE

- 3097 - FAILED_INITIAL_POST
- 3098 - FLASH_PARAMS_REINITIALIZED

- 3099 - UNIDENTIFIED_ERROR

Part Numbering Schema



Standard Part Numbers

Single-Mode Digital D-Type

Wavelength (nm)	Output Power (mW)	Part Number	Integral Optical Isolator
633	30	I0633SD0030B-IS-HD	YES
638	35	I0638SD0030B-IS-HD	YES
660	50	I0660SD0050B-IS-HD	YES
780	100	I0780SD0100B-IS-HD	YES
785	100	I0785SD0100B-IS-HD	YES
808	100	I0808SD0100B-IS-HD	YES
830	100	I0830SD0100B-IS-HD	YES
1064	150	I1064SD0150B-HD	NO

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